Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2023, 13(3), 15-19, doi: 10.15421/2023_434

ORIGINAL ARTICLE

Participatory demonstration of alternative and conventional furrow irrigation on onion (*Allium cepa L.*) yield and water productivity in meskan woreda gochejib irrigation scheme, southern Ethiopia

T. Bekele*, M. Ahmed

Worabe Agricultural Research Center, Natural Resource Research Directorate, Irrigation and Drainage Research Researchers, Worabe, Ethiopia

**Corresponding author E-mail: tage2005@gmail.com*

Received: *15 March, 2023; Manuscript No: UJE-23-92790;* ***Editor assigned:*** *17 March, 2023, PreQC No: P-92790;* ***Reviewed:*** *28 March, 2023, QC No: Q-92790;* ***Revised:*** *03 April, 2023, Manuscript No: R-92790;* ***Published:*** *10 April, 2023*

In semi-arid areas of Ethiopia, water is the most limiting factor for crop production. Due this introducing different water saving technologies in needed. This on farm demonstration was done in Meskan passidp-II target irrigation scheme to assess AFI and conventional furrow irrigation effect on Onion yield and water productivity. Six clustered model farmers field used as sample demonstration site. The comparative treatments were AFI full irrigation application (100% ETc) (4 days irrigation interval) and Conventional/Farmer Practices (6 days irrigation interval) as control. Plot size was 10m by 10m on each farmer's field. One year conducted result shows that maximum Onion bulb yield (9.082 ton/ha) and WP (3.79 kg/m^3) were recorded on AFI application in 4 days irrigation interval. Minimum onion bulb yield (6.94 ton/ha) and WP (1.97 kg/m^3) were obtained at conventional/farmers practice in 6 days irrigation interval. Therefore, using AFI application, there was significant yield difference between AFI and Farmers' practice. Therefore, AFI practice is recommended to improve Onion production and WP in study area/scheme with recommended full packages.

Keywords: Alternative furrow irrigation, Conventional furrow irrigation, Demonstration and water productivity.

Introduction

In semi-arid areas of Ethiopia, water is the most limiting factor for crop production (Mihret and Ermias, 2014). To achieve sustainable irrigated agriculture with limited water resources; it is necessary to introducing different water saving technologies and guidelines for irrigation water users (Geerts and Raes, 2009).

Different techniques of saving agricultural water use have been investigated globally. Various researchers (Stone and Nofziger, 1993) have used wide spaced furrow irrigation or Alternative furrow irrigation or skipping crop rows as a means of improving WUE. They selected some furrows for irrigation while other adjacent furrows were not irrigated for the whole season i.e., fixed furrow irrigation (FFI) which means that irrigation is fixed to one of the two neighboring furrows. Alternative furrow irrigation practice is one of the possible irrigation water management techniques that may help farmers to apply a limited amount of water to their crops in time and amount vital for optimum crop water productivity. Alternative furrow irrigation gave the highest yield of corn and water productivity (Abd El-Halim, 2013). One of the ways to improve efficiency is reducing water use and consequently pumping costs without significantly reducing yield through the use of alternate furrow irrigation (Hodges et al., 1989). So, this study to demonstrate the best water saving alternative furrow irrigation systems without significant yield reduction of Onion. Onion is one of popular vegetable crops in Ethiopia and its area coverage is increasing from time to time mainly due to its high profitability per unit area, ease of production and it's important in the daily diet (Lemma and Herath, 1992).

Objectives

- To demonstrate the effect of alternate & fixed furrow irrigation with farmer Practice on Onion yield and water use efficiency.
- To assess farmers preferences on alternative and conventional furrow irrigation systems that achieved high water use efficiency with insignificant yield reduction.

Materials and Methods

Description of study areas

The demonstration was done in two passidp-2 targeted irrigation schemes. Meskan woreda/Gochejib scheme in Gurage zone. Annual rainfall of study area ranges from 500 to 800 mm. The mean annual temperature ranges from a minimum of 11.8°C to a maximum of 27.4°C. The soil of the experimental area is dominated by red and gray color with clay texture.
The activities were conducted in collaboration with SARI and PASIDP-II project donors. Accordingly periodical supervision and monitoring was jointly conducted by the SARI and PASIDP coordinators and the respective Zonal and districts focal persons. Moreover, close follow up done by the worabe agricultural research center irrigation researchers, members of FREG, Kebele experts and focal persons of the project in the study areas.

Agronomic management

Wheat agronomic practices under both irrigation schemes mentioned in Table 1 below used recommended fertilizer rate and urea top-dressed, spacing, chemicals were applied as recommendations made for crops in the areas. To control weed competition for essential nutrients, manual and chemical (Palace) were used during plant growth period.

Table 1. Implemented schemes and agronomic parameters.

Implementing Center	Schemes	Woreda	Crop	Spacing of furrow cm	Variety	Fertilizer	
						NPS (kg)	**Urea (kg)**
Werabe Agricultural Research Center	Gochejib	Meskan	Onion	40	King Red	200	150

Treatments

Alternative irrigation (with 100% ETc application) (4 days irrigation interval).
Farmer Practices or Conventional irrigation (6 days interval).

Design

- Spacing row and plant were 20 cm and 10 cm, respectively
- Replication=Six clustered farmer as replication
- RCBD with four replications (farmers were as replication)
- Plot size=10 m * 10 m
- Space between plots, furrow & plant were 1 m, 40 cm, 10 cm, respectively
- Test crop: Onion (king red).

Crop water determination and irrigation scheduling

Crop water requirement refers to the amount of water that needs to be supplied, while crop evapotranspiration refers to the amount of water that is lost through evapotranspiration (Allen, et al., 1998). For the determination of crop water requirement, the effect of climate on crop water requirement, which is the reference crop evapotranspiration (ETO) and the effect of crop characteristics (Kc) are important (Doorenbos and pruitt, 1977). The long term and daily climate data like maximum and minimum air temperature, relative humidity, wind speed, sunshine hours, and rainfall data of the study area were collected to determine reference evapotranspiration. Crop data like crop coefficient, growing season and development stage, effective root depth, critical depletion factor of vegetable crop and maximum infiltration rate and total available water of the soil was be determined to calculate crop water requirement using CropWat 8.0 model.

$ETc = ETo \times Kc$

Where: ETc=crop evapotranspiration, Kc=crop coefficient, ETo=reference evapotranspiration.

Irrigation water management

The total available water (TAW), stored in a unit volume of soil was be determined by the expression.

$TAW = [(FC - PWP) \times Bd \times Dz]/100$

For maximum crop production, the irrigation schedule should be fixed based on readily available soil water (RAW). The RAW could be computed from the expression:

$RAW = (TAW \times p)$

Where, RAW in mm, p is in fraction for allowable/permissible soil moisture depletion for no stress and TAW is total available water in mm.

The depth of irrigation supplied at any time can be obtained from the equation

$NI(mm) = (ETc_{mm} - Peff_{mm})$, this cas $Peff_{mm} = 0$

The gross irrigation requirement (dg) was computed by adopting a field application efficiency of 60% (FAO, 1989). Ea=application efficiency of the furrows (60%).

$dg = NI/Ea$

The time required to deliver the desired depth of water into each plot calculated using the equation:

$t = (l \times w \times dg)/6Q$

Where: dg=gross depth of water applied (cm), t=application time (min), l=furrow length in (m), w=furrow spacing in (m), and Q=flow rate (discharge) (l/s).

Implemented approach

Participatory on farm demonstration approach implemented to boost adoption of irrigation scheduling practices on Onion production. All members of FREGs were actively involved on training of irrigation furrow preparation, plantation and weed management practices up to harvesting. Six trial farmers selected from FREG members by considering on willingness to participate, availability of suitable farmland and access to road facility, and as much as possible female households.

Organizing field day

Prior to implementing the activities in the target area both theoretical and on-farm training were given to all members of FREG and Kebele experts in each irrigations scheme demonstration site to enabling the target participant farmers to acquire awareness and practical skill on the improved irrigation management practices. In case of Gombora field was organized but in meskan case not. By inviting members of the FREGs, model farmers in the localities, key stakeholders from the corresponding kebeles, Districts, Zones and were participated in the field day demonstration.

Agronomic practices and management

The crops and irrigation scheme under each irrigation schemes mentioned used fertilizer rate and Urea, spacing and chemicals applied as recommendations made for crops in the areas. To control weed competition for essential nutrients appropriate weed control techniques were applied during plant growth period.

Collected data

- The irrigation water applied Yield and components, Agronomic data and farmers' preference.

Data analysis

- The collected data were analyzed using Statistical Agricultural Software (SAS) and descriptive method.

Results and Discussion

Result in the Table 2 shows that there was no statistical significant difference between treatment mean in plant height. But there were statistically significant difference between treatments means both on yield and water productivity. Maximum yield (9.08 ton/ha) and WP (3.97 kg/m^3) were obtained from treatment having AFI with full irrigation application (in 4 days irrigation interval) whereas minimum yield (6.94 ton/ha) and WP (1.97 kg/m^3) were obtained from farmer practice (in 6 days irrigation interval). This study in line with the study done by (Nelson et al., 1996 and Gezimu G., 2022) AFI improves WP and economic benefit (Fig. 1).

Table 2. Mean yield and yield component wheat data.

Treatments	Meskan Scheme			
	Ph (cm)	**Yield (ton/ha)**	**AW (mm)**	**WP (kg/m^3)**
1. AFI	445.89	9.08[a]	239.75[a]	3.79[a]
2. F/Practice	44.25	6.94[c]	350.75[b]	1.97[c]
CV	4.25	3.12		
LSD (0.05)	NS	0.40		

bn-branch number, ph-plant height, AW-Applied Water, F-Farmer, WP-Water Productivity.

Fig. 1. Field performance picture.

During maturity stage of Onion, farmers and other stockholder invited on field day conducted to share experiences of best practice of demonstrated site. On the field day participants such as Zone PASSIP-II focal, woreda administration, woreda PASSIP-II focal, woreda agricultural development, woreda farm manager, Irrigation experts, horticultural expert, SWC expert, kebele DAs, kebele administration and 30 farmers, totally 40 stockholders were participated. Finally farmers preferences were collected from sample farmers.

Conclusion

At meskan case, One year field demonstration shows that Maximum yield (9.082 ton/ha) and WP (3.79 kg/m^3) were recorded on AFI. Minimum yield (6.94 ton/ha) and WP (1.97 kg/m^3) were obtained at farmers practice. Therefore, AFI is recommended to improve Onion production and WP in the study area.

References

El-Halim, A. (2013). Impact of alternate furrow irrigation with different irrigation intervals on yield, water use efficiency, and economic return of corn. Chilean Journal of Agricultural Research, 73:175-180.

Allen, R.G., Pereira, L.S., Raes, D., Smith, M. (1998). Crop evapotranspiration-Guidelines for computing crop water requirements-FAO Irrigation and drainage paper 56. Fao, Rome, 300:D05109.

Asfaw, Z., Eshetu, D. (2015). Production and management of major vegtable crop, in Ethiopia. Adis Abeba, Ethiopia: Ethiopia Agricultural Research Institute.

Doorenbos, J., Pruitt, W.O. (1977). Crop water requirements. FAO irrigation and drainage paper 24. Land and Water Development Division, FAO, Rome.

Agriculture Organization of the United Nations. Conference. (1989). Sustainable development and natural resources management. Food and Agriculture Organization of the United Nations.

Geerts, S., Raes, D. (2009). Deficit irrigation as an on-farm strategy to maximize crop water productivity in dry areas. Agricultural Water Management, 96:1275-1284.

Gelu, G. (2022). Alternative furrow irrigation effect on onion (*Allium cepa L.*) yield and water use efficiency: Evidence from Ethiopia. Communications in Soil Science and Plant Analysis, pp:1-9.

Hodges, M.E., Stone, J.F., Garton, J.E., Weeks, D.L. (1989). Variance of water advance in wide-spaced furrow irrigation. Agricultural Water Management, 16:5-13.

Desalegne, L., Herath, E. (1994). Agronomic studies on Allium. National Horticultural Workshop of Ethiopia, Addis Abeba (Ethiopia), IAR.

Ulsido, M.D., Alemu, E. (2014). Irrigation water management in small scale irrigation schemes: The case of the Ethiopian rift valley lake basin. Environmental Research, Engineering and Management, 67:5-15.

Nelson, D.W., Sommers, L.E. (1996). Total carbon, organic carbon, and organic matter. American Society of Agronomy and Soil Science Society of America, Madison, Wisconsin, USA, 9:961-1010.

Stone, J.F., Nofzger, D.L. (1993). Water use and yields of cotton grown under wide spaced furrow irrigation. Agricultural Water Management, 24:27-38.

Citation:

Bekele, T., Ahmed, M. (2023). Participatory demonstration of alternative and conventional furrow irrigation on onion (*Allium cepa L.*) yield and water productivity in meskan woreda gochejib irrigation scheme, southern Ethiopia. *Ukrainian Journal of Ecology.* 13:15-19.